

SEMESTER –VI
ENVIRONMENTAL AND GREEN CHEMISTRY
THEORY

Program: B.Sc.
Course Code: U20/CHE/DSE/602
Course Type: DSE 2
No. of Credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

COURSE OBJECTIVES:

- To study the effects of chemical synthesis upon the environment and the importance of developing green techniques.
- To discern the environmental consequences of chemical manufacturing and illustrate how these may be minimized.
- To understand the structure of the atmosphere and the importance of the various layers.
- To enlighten students about the industrial effluents, their impact on the environment and the methods of minimizing.

COURSE OUTCOMES:

- CO 1:** Recall the segments of environment and summarize the effects of pollution on global climate.
- CO 2:** Outline the methods of waste treatment and utilize them for safer environment.
- CO 3:** Acquire the ability to design green synthetic routes replacing conventional path ways.
- CO 4:** Develop a sense of social responsibility and propose sustainable solution for environmental problems

MODULE 1: INTRODUCTION TO ENVIRONMENTAL CHEMISTRY (11 Hrs)

Introduction to environment and segments of environment (Brief account only) (1 Hr)

Earth's atmosphere

Regions of the atmosphere, Tropospheric Chemistry: smog, classification of smog and acid rain. Stratospheric chemistry: The ozone layer, formation and turnover of ozone, catalytic decomposition of ozone.

Chemistry of Global Climate (5 Hrs)

Composition, energy balance, Greenhouse gases and aerosols, Greenhouse effect, Global Warming, Greenhouse gases associated with use of carbon based fuels, Remedies to the problem. Effects of Air Pollution on living organisms and vegetation.

Sources and nature of water pollution, Impact of water pollution on hydrological cycle and aquatic ecosystem.

MODULE 2: WASTE MANAGEMENT (11Hrs)

Water purification methods (5 Hrs)

Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

Industrial waste management (4 Hrs)

Incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

Disposal of nuclear waste, nuclear disaster and its management. (2 Hrs)

MODULE 3: PRINCIPLES OF GREEN CHEMISTRY (11Hrs)

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry, Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanation and examples. Atom economy, Evaluation of the type of the reaction: Rearrangements, Addition, Substitution, elimination and Pericyclic reactions. Selection of solvent: Aqueous phase reactions, Reactions in ionic liquids, Solid supported synthesis, Solvent free reactions (solid phase reactions). Green catalysts: Phase Biocatalysts. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.

MODULE 4: EXAMPLES OF GREEN SYNTHESIS AND SOME REAL WORLD CASES**(11Hrs)**

Microwave assisted reactions in water: Hoffmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols, Claisen rearrangement, Pinacol pinacolone rearrangement.

Microwave assisted reactions in organic solvents, Diels-Alder reaction and Decarboxylation reaction, Fries rearrangement.

Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine), Cannizzaro reaction, Strecker synthesis, Dieckmann condensation, Friedal crafts acylation.

Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis). An efficient green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.

Text Books:

1. Dara.S.S,(2008 Reprint), *A Textbook Of Engineering Chemistry*, New Delhi, S. Chand &
2. Company Ltd.
3. Sharma B.K & Kaur .H, *Environmental Chemistry*: Goel Publishing House, Meerut.
4. Vanloon, G. W., & Duffy, S. J. (2005). *Environmental Chemistry: A Global Perspective*.
5. Oxford: Oxford University Press.
6. Ahluwalia V.K, *Green Chemistry: Environmentally Benign Reaction*: Ane Books Pvt.Ltd,2006.
7. Ahluwalia V.K & Kidwai M, *New Trends In Green Chemistry*: Springer,1edition (29th Feb 2004)

Reference Books:

1. A.K. De. (First Print 1947,6th edition-2006), *Environmental Chemistry*: New Delhi, New Age International Pvt. Ltd.
2. Thomas g.spiro & William m. stigliani , *Chemistry of the environment* : (2nd edition) prentice hall; (march 29 2002) Samuel delvin, *Green chemistry* : sarup & sons (2005)

SEMESTER-VI
MODEL QUESTION PAPER
THEORY

Course Code: U20/CHE/DSE/602

Max. Marks: 60

Credits: 3

Max. Time: 2 Hrs

SECTION – A

I. Answer the following

4 x 10 = 40 M

1. a) Explain the causes and consequences of acid rain. (CO1) 6M
 b) Justify that living organisms get affected by air pollution. (CO1) 4M

OR

2. a) Summarize the association of green house gases with carbon based fuels.(CO1) 5M
 b) Interpret the impact of water pollution on hydrological cycle and aquatic ecosystem. (CO1) 5M
3. a) Compare the water quality parameters for waste water, industrial water and domestic water. (CO2) 6M
 b) Justify a course of action for industrial effluent treatment from textile industry. (CO2) 4M

OR

4. a) Summarize various water purification methods. (CO2) 5M
 Explain how nuclear waste is disposed. (CO2) 5M
5. a) Write the basic principles of green chemistry. (CO3) 6M
 b) What is atom economy? Calculate atom economy using suitable example. (CO3) 4M

OR

6. a) Write a note on the need for green chemistry. (CO4) 5M
 b) Interpret the selection of solvents in green synthesis. (CO3) 5M
7. a) Using water as a solvent, how are pinacolone and benzoic acid synthesized by microwave technique. (CO3) 4M
 b) How ultrasound technique is implemented in the following 6M
 i) Dieckmann condensation ii) Friedel crafts acylation iii) Simmons-Smith Reaction

OR

8. a) How are Surfactants for carbon dioxide advantageous for precision cleaning of garments when compared to PERC?(CO3) 5M
 b) Outline the green synthesis of catechol, disodium iminodiacetate 5M

SECTION – B**II. Answer any FOUR.****4 x 5 = 20 M**

9. What is Photochemical smog? Write about its photochemistry. (CO1)
10. Explain how chlorofluorocarbons deplete the ozone layer. (CO1)
11. Explain the treatment of effluents from the Petroleum and Petrochemical industries.(CO 2)
12. Interpret the role of phase transfer catalyst in green synthesis. (CO 3)
13. Reactions in ionic liquids are greener, Justify. (CO 3)
14. Outline the reactions involved in synthesis of poly lactic acid from corn. (CO 4)